## AMENDMENTS TO THE SPECIFICATION

Please replace page 1, line 3 (numbered line 1) - page 7, line 23 as follows:

### BACKGROUND

The invention relates to a component placement device that includes: (a) ~~which has~~ a holder and (b) a nozzle that is connected to the holder and that is provided with a duct. The invention further relates to a nozzle exchange device. The invention also relates to a method for the exchange of nozzles.

In a similar assembly known from ~~United States patent US-A 5,831,504 for component placement~~ U.S. Patent No. 5,831,504, a nozzle that extends ~~extending~~ along an axis is slidably disposed in a holder. In a duct, which extends ~~extending~~ through the nozzle, ~~nozzle~~ a vacuum is built-up ~~built up~~ by means of which a component is picked-up ~~picked up~~ by the nozzle and placed on a substrate. If relatively large forces directed parallel to the axis are exerted on the nozzle, the nozzle is slid into the holder so that the maximum force exerted on the component is limited. Disadvantageously, however, if undesired ~~If undesired~~ forces in a radial direction transverse to the axis are exerted on the nozzle, the nozzle will deform or break off. A further disadvantage of such a known assembly is that a nozzle cannot be readily exchanged. In addition, between the nozzle and holder, which ~~which~~ can be moved relative to each ~~other~~ other, there may be wear and/or contamination, which is undesired.

It is an object of the present invention to provide a device whose nozzle can be separated from the holder in a simple manner.

### SUMMARY

The aforementioned ~~This~~ object is achieved by the device according to the invention in which ~~that~~ the nozzle is detachably connected to the holder, which ~~holder~~ has a passage extending coaxially to the duct.

The device according to the invention is advantageous in that various nozzles can be detachably attached to the holder. As a result, ~~so that~~ components of different sizes can be placed on a substrate by means of various nozzles. The vacuum needed for ~~picking up~~ picking-up a component can be built-up ~~built up~~ through the passage in the holder and the connecting duct in the nozzle. In addition, in case of a collision of the nozzle, when forces are exerted on the nozzle in a radial direction transverse to the axis, the nozzle may be separated from the holder, so that at least damage to the holder is avoided.

An embodiment of the device according to the invention is characterized in that the nozzle, when in operation, can be decoupled from the holder in a radial ~~radial~~ direction relative to the axis of the duct when a predetermined force exerted on the nozzle in radial direction is exceeded. Such an embodiment is advantageous in that if the device accidentally collides with an object in its environment, the nozzle is separated from the holder as a result of the forces working in radial direction and resulting from the collision. Consequently, the entire device is not ~~the whole device is~~ damaged in case of such a collision. Rather, ~~but only~~ only the relatively cheap nozzle is separated from the device. Furthermore, the possibly damaged nozzle can quickly be replaced, so that generally continuous use of the device remains guaranteed.

Another embodiment of the device according to the invention is characterized in that the nozzle can be detachably (and simply) attached to the holder by means of at least one magnet. ~~The holder and the nozzle are connected to each other in a simple manner by means of a magnet.~~ Furthermore, the magnetic force can be predetermined, so that the force necessary for separating the nozzle from the holder is known.

A still further embodiment of the device according to the invention is characterized in that the holder and the nozzle can be aligned to each other. By aligning ~~them~~ the holder and the nozzle, the duct of the nozzle and the passage of the holder can be accurately connected. As a result, ~~so that~~ a proper vacuum in the duct and the passage can be ~~built up~~ built-up.

A further embodiment of the device according to the invention is characterized in that the holder and three radially extending grooves in the holder and in the nozzle are ~~located apart, with a~~ separated. Spheres are ~~sphere being~~ located between opposite grooves in the holder and the nozzle. As a result of the grooves collaborating by means of the ~~sphere~~ spheres, the holder and the nozzle can be aligned to each other in a relatively simple and fast manner.

A still further embodiment of the device according to the invention is characterized in that in the ~~holder and the nozzle~~ three grooves of the holder and the nozzle are ~~120 degrees~~ 120° apart. As a result of such a spreading of the grooves, the holder and the nozzle fit together in a number of ways and can, therefore, ~~can therefore~~ be aligned to each other in a simple manner.

A still further embodiment of the device according to the invention is characterized in that the duct and/or passage have/has a filter. Such an embodiment is advantageous in that the air sucked-in, ~~sucked in~~ as a result of the vacuum in the duct and the ~~passage~~ passage, is

filtered. As a result, ~~so that~~ the duct, the passage and the vacuum pump connected to the passage will not be contaminated or ~~even~~ clogged.

A still further embodiment of the device according to the invention is characterized in that the nozzle includes an identification means. An advantage of such an embodiment is that various nozzles can be readily ~~simply~~ recognized. The identification means may be, for example, a bar code, dot code or alphanumeric code which can be recognized by means of a CCD camera or laser. An alphanumeric code is advantageous in that it can be also read by a human ~~being also~~ without an aid, which may be of advantage when the nozzle is fitted for the first time. It is alternatively possible to provide each nozzle with a unique section at a predetermined spot, which section can easily be determined and verified by means of a camera or laser.

A still further embodiment of the device according to the invention is characterized in that the nozzle has a groove in a circumferential wall. For the nozzle to be separated from the holder, the holder may be retained ~~it can be taken up~~ by means of the groove.

The nozzle exchange device according to the invention is characterized in that ~~in the nozzle exchange device~~ a nozzle that is detachably connected to a holder can be exchanged. Such a nozzle exchange device is advantageous in that nozzles can be relatively simple to decouple, store and couple therein.

A method ~~The method~~ according to the invention is characterized in that a device comprising a holder and a detachable nozzle are moved to a nozzle exchange device in which the nozzle is separated from the holder, after which the holder is coupled to another nozzle. An advantage of such a method is that the holder can be decoupled from a first ~~certain~~ nozzle and coupled to a second ~~a new~~ nozzle in a relatively simple manner by means of the nozzle exchange device.

Another embodiment of the method according to the invention is characterized in that ~~in the nozzle exchange device~~ the device is axially moved in a spacious cavity (also referred to as a "large opening"). Subsequently, ~~after which~~ the nozzle is moved to a narrow cavity ~~connecting~~ (also referred to as a "small opening") connected to the large opening ~~spacious cavity~~ by means of a displacement transverse to the axial displacement. In the small opening, ~~in which narrow cavity~~ the nozzle is clamped and is, thereafter, ~~after which it is~~ separated from the holder by means of an axial displacement. At that time, ~~and the~~ the holder is moved to another nozzle. An advantage of such an embodiment is that with a relatively simple lock-like ~~construction (spacious cavity and a narrow enveloping cavity connecting to the spacious cavity)~~ construction, the nozzles can be decoupled from the holder.

A further embodiment of the method according to the invention is characterized in that an identification means situated on the nozzle is scanned by a camera or a laser, after which the nozzle is recognized from the identification means. An advantage of such an embodiment is that by means of the reading of the identification means by a laser, the identification means can be used both for identification and verification purposes of the nozzles. As a result, ~~so that it can be verified~~ the identification means can verify whether the right nozzle is attached to the holder.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only, and are not restrictive of the invention as claimed.

## BRIEF DESCRIPTION OF THE DRAWINGS

These and other ~~aspects of the invention are apparent from and will be elucidated with reference to the embodiments described hereinafter~~ features, aspects, and advantages of the present invention will become apparent from the following description, appended claims, and the accompanying exemplary embodiments shown in the drawings, which are briefly described below.

~~In the drawings:~~

Fig. 1 is a ~~shows a diagrammatic~~ cross-sectional view of an embodiment of a placement device according to the ~~invention,~~ invention;

Figs. 2A-2B are ~~diagrammatically show~~ cross-sectional views of different nozzles of a placement device according to the ~~invention,~~ invention;

Fig. 3 is ~~shows~~ a plan view of a nozzle exchange device according to the ~~invention,~~ invention;

Fig. 4 is a ~~shows a diagrammatic~~ cross-sectional view of the nozzle exchange device shown along the line I-I in ~~Fig. 3, and~~ Fig. 3; and

Figs. 5A-5D ~~show a~~ are sectional, bottom ~~view~~ plan, bottom perspective, and ~~view and front~~ top perspective views, respectively, ~~respectively~~ of another embodiment of a placement device according to the invention.

## DETAILED DESCRIPTION

Efforts have been made throughout the drawings to use the same or similar reference numerals for the same or like components.

~~In the drawing Figures the same reference numbers have been used to indicate corresponding components.~~

Fig. 1 shows a device 1 according to the present invention that~~, which device~~ is suitable for placing components such as, for example, SMDs, Ball Grid Arrays (BGAs), CSPs, SOTs, SOPs, SOICs, PLCCs, QFPs, ~~QFPs~~ etc. The device 1 comprises a holder 2 and a nozzle 3. The holder 2 has a passage 5 that extends ~~extending~~ along an axis 4 of the holder 2. The passage 5~~, which passage~~ is connected to a vacuum pump or other vacuum appliance (not shown) on a side that faces ~~facing~~ away from the nozzle 3. The side of the holder 2 ~~facing~~ that faces the nozzle 3 comprises two magnets 6, 7 or a single annular magnet. Furthermore, this side of the holder 2 has three grooves 8 that ~~which~~ are arranged 120° apart around the circumference of the holder ~~2 120 degrees apart~~ 2.

The nozzle 3 comprises identification means 15 and a duct 10 that extends along an ~~extending along the~~ axis 9 of the nozzle 3. The identification means 15, which may be read by a visualizing device such as a camera or a laser, may be in the form of alphanumeric code, a bar code, dot code, etc. The duct~~, which duct~~ 10 or the passage 5 comprises a filter 11 by means of which dust particles can be ~~received~~ trapped; in the shown embodiment the filter 11 is provided in the duct 10. The side of the nozzle 3 that faces ~~facing~~ the holder 2 is made of a material that has ~~having~~ magnetic properties~~, such as iron~~ such as metal and more particularly such as iron. This side has three grooves 12, which ~~which~~ are arranged ~~120 degrees~~ 120° apart around the circumference of the nozzle 3.

The nozzle 3 can be detachably connected to the holder 2. The nozzle 3 and the holder 2 are coupled to each other by means of the magnets 6, 7 of the holder 2 that interact with the magnetic material of a contact face of the nozzle 3. The holder 2 and the nozzle 3 are aligned ~~and aligned~~ to each other by means of the opposed grooves 8, 12 ~~lying opposite each other~~ and spheres 13 located in the ~~these~~ grooves. The axis 4 of the passage 5 of the holder 2 then corresponds to the ~~axis 8~~ axis 9 of the duct 10 of the nozzle 3, so that the duct 10 and the passage 5 are in fluid communication ~~form a whole~~ after coupling. By means of the spheres 13, ~~spheres 13~~ the nozzle 3 can be simply and properly aligned to the holder 2 ~~in the right position~~ (i.e., the position in which the ~~axis 8~~ axis 9 of the duct 10 corresponds to the axis 4 of the passage 5). ~~The holder 2 and the nozzle 3 are kept together by the magnetic force of the magnets 6, 7 which acts on the metal contact face of the nozzle 3.~~ A vacuum for ~~picking up~~ picking-up a component ~~at the~~ at an end 14 of the duct 10 can be ~~built up~~ built-up in the duct 10 and the passage 5 by means of a vacuum pump or other vacuum system.

Figs. 2A-2B respectively show diagrammatic cross-sections of two different embodiments of nozzles 3', 3". Each of the nozzles 3', 3" has ~~which have each~~ a different end 14', 14" by which different sorts of components can be picked-up ~~picked up~~ in optimum

fashion. These nozzles 3', 3" can be detachably attached to a holder 2. Each nozzle 3', 3" comprises at least one ~~least a~~ groove 20 that extends ~~extending~~ along the circumference thereof, the function of which groove will become apparent with reference to the Figs. 3 and 4.

The surface of the end 14 of the duct 10 depends, among ~~on among~~ other things, on the dimensions ~~such as~~ and the mass of a component as well as ~~component,~~ the available space for placing the component on the ~~substrate etc~~ substrate. The nozzle 3' shown in Fig. 2A is more suitable for picking-up ~~picking up~~ large components than the nozzle 3" shown in Fig. 2B, because the surface area of the end 14' of the nozzle 3' is larger, thereby enabling a larger component to attached thereto ~~so that the component is attached to the end 14~~ in a stabler manner. In contrast, the nozzle ~~The nozzle~~ 3" is more suitable for ~~picking up~~ picking-up relatively small components.

Fig. 3 shows a plan view of a nozzle exchange device 30. The nozzle exchange device 30 comprises eight exchange elements 31. Each exchange element 31 has a slotted opening consisting ~~of an opening 32~~ of a large diameter opening 32 and a small diameter ~~connecting~~ opening 33 ~~of a smaller diameter~~ connected to the large opening 32. Each exchange element 31 has a spring 34 one end of which ~~one end~~ is located in a chamber 35 and ~~of which~~ the other end of which is situated between the two openings 32, 33. Fig. 4 shows a diagrammatic cross-section of a nozzle 3 situated in an exchange element 31.

The operation of the nozzle exchange device 30 will now be briefly discussed. The holder 2 with the nozzle 3 is moved by means of displacement means (not shown) to a position above an exchange element 31 in the nozzle exchange device 30. Thereafter, ~~after which~~ the device 1 is vertically moved in the direction indicated by arrow P1 into the large ~~in an~~ opening 32 of the exchange element 31, until the nozzle is located inside the exchange element 31 and the groove 20 of the nozzle 3 is at the same height ~~as the~~ as an edge 40 of the small opening 33 of the exchange element 31. Subsequently, the device 1 is horizontally moved in the ~~horizontal~~ direction indicated by the arrow P2 into the corresponding small opening 33 of the exchange element 31, thereby laterally pressing ~~having the smallest diameter, while~~ the spring 34 ~~is pressed sideways~~ against resilience. After the horizontal displacement, the nozzle 3 is held ~~enclosed~~ by the edge 40 of the small opening 33 ~~having the smallest diameter as well as~~ and the compressed ~~rebounded~~ spring 34. The spring 34 exerts a force on a wall 41 of the nozzle 3 as can be seen in Fig. 4, so that the nozzle 3 is firmly clamped between the spring 34 and the edge 40 of the small opening 33 of the exchange element 31.

The holder 2, which is connected to the nozzle ~~3 is~~ 3, is then upwardly (i.e., vertically) moved ~~up in vertical direction,~~ in an opposite direction to the arrow P1. As a result, ~~while~~ a connecting force, for example between the two magnets 6, 7 of the holder 2 and the magnetic ~~metal~~ surface of the ~~nozzle 2~~ nozzle 3, is exceeded, thereby decoupling ~~so that~~ the nozzle 3 ~~is decoupled~~ from the holder 2. The holder 2 is then moved to a position above ~~another nozzle 2~~ a second nozzle 3 located in the nozzle exchange device 30. Subsequently, ~~after which~~ the holder 2 is detachably coupled to the second ~~another~~ nozzle 3 by means of, for example, the magnets 6, 7. The device 1 is then moved to the large opening 32 ~~having the largest diameter~~ (i.e., in a direction opposite to the arrow P2) of the exchange element 31 associated with the second nozzle 3, thereby relieving ~~while~~ the tension of the spring 34 ~~is exceeded~~. As soon as the device 1 is in the ~~opening 33 having the largest diameter~~ corresponding large opening 32, the placement device 1 is upwardly (i.e., vertically) moved ~~up in vertical~~ (i.e., in the direction opposite to arrow P1).

Figs. 5A and 5D show another embodiment of a device 51 according to the invention ~~which~~ that largely corresponds to the device 1 shown in Fig. 1. The device 51 comprises a holder 52 and a nozzle 53 detachably coupled therewith. The holder 52 comprises a passage 5 that extends ~~extending~~ along an axis 4 of the holder 2, which passage 5 is connected to a vacuum system on a side that faces ~~facing~~ away from the nozzle 53. The holder 52 and the nozzle 53 are detachably coupled to each other by means of an annular magnet 6. The nozzle 53 comprises a duct 10, which extends ~~extending~~ along the axis 9 of the nozzle ~~53, which~~ 53 and which terminates ~~duct is suitable~~ at an end 14''' at which ~~for picking up~~ components may be picked-up by means of a vacuum built-up ~~built up~~ in the duct 10. On a side that faces ~~facing~~ away from the ~~end 14~~ end 14''', the duct 10 has a funneled end 54 in which there is a protrusion 55 that extends ~~extending~~ from the holder 52. The holder 52 as well as the protrusion 55 contain the ~~have a~~ passage 5, which ~~that~~ is connected to the duct 10. The protrusion 55 on a side that faces ~~facing~~ the nozzle 53 has a beveled ~~side~~ edge 56 that ~~which~~ preferably has an inverted involute ~~a subinvolute~~ shape. If a relatively large force is exerted on the nozzle 53 in radial direction relative to the axis 9, the nozzle 53 will tilt relative to the holder 52 and, thanks to the beveled ~~edges~~ edge 56 will come loose from the holder 52 without ~~damaging it~~ substantially damaging the nozzle 53 or the holder 52. When the nozzle 53 is attached to the holder 52, the protrusion ~~56 together with~~ 55 and the funneled end 54 ~~serves for centering~~ serve to center the nozzle 53 and the holder 52 relative to each other.

The nozzle 53 has a groove 20 that extends ~~extending~~ along the circumference of the nozzle 53. The groove 20, ~~which groove~~ is, as previously ~~has already been~~ described ~~above~~,

suitable for removing the nozzle 53 from the holder 52 in a simple way ~~in for example~~ in, for example, a nozzle exchange device 30. As ~~Since~~ the groove 20 is ~~52 is~~ relatively close to the holder 52, no forces will be exerted on the nozzle 53 when the ~~holder 51~~ holder 52 and the nozzle 53 are displaced in the nozzle exchange device 30 in the direction indicated by the arrow P1 when the spring 34 is pushed aside. As a result, ~~so that~~ the nozzle 53 ~~is prematurely~~ may not be separated from the holder 52. ~~Not~~ until the moment when the nozzle 53 is in the small opening 33 ~~having a relatively small diameter can~~ at which time the force exerted on the nozzle 53 by the magnet 6 may be overcome by moving the holder 52 in a direction opposite to the arrow P1. Accordingly, ~~so that~~ the holder 52 and the nozzle 53 are separated in a simple manner.

Given the disclosure of the present invention, one versed in the art would appreciate that there may be other embodiments and modifications within the scope and spirit of the invention. For example, it should be readily apparent ~~It is observed~~ that the passage 5 and the duct 10 ~~cannot only~~ can be connected to each other both in a coaxial manner ~~but also~~ and at an angle. Further, it is alternatively or additionally ~~It is alternatively~~ possible to detachably connect the holder and the nozzle by means of vacuum.

Accordingly, all modifications attainable by one versed in the art from the present disclosure within the scope and spirit of the present invention are to be included as further embodiments of the present invention. The scope of the present invention is to be defined as set forth in the following claims.